19. (Amended) An energy storage device having a compound of any one of the [general] formula (1) to (3):

$$A_aS \quad (1)$$

$$B_bD_{(1-b)}S_y \quad (2)$$

$$E_eG_gJ_{(1-e-g)}M_mS_z$$

where A is Cu, Ag or Au, and $0.4 \leq a \leq 5$; B and D are different from each other, and are each selected from the group consisting of Cu, Ag, Au, Zn, Al, W and Li; $0.001 \leq b \leq 0.999$; $0 < y < 2$; E, G and J are different from each other, and are each selected from the group consisting of Cu, Ag, Au, Zn, Al, W, Li and Mg; M is Ca, Sr, Na, K, Rb, O, F, Cl, Br or [1] I; $0.001 < e < 0.999$; $0.001 < g < 0.999$; $0 \leq m \leq 0.2$; and $0 < z < 2$ (1+m), as an active material of a negative electrode, in an amount of 75 % by weight or more of the composition of the negative electrode.

Claim 5, line 3, delete "$3Ag_2S \cdot Ag_2S_3$,"; same line, delete "AuS_2" and insert --$Au_{0.5}S$--.

Claims 2, 4 and 5, line 1 of each, delete "1" and insert --21--.

REMARKS

Claim 1 has been canceled. Claims 6-18 and 20 stand withdrawn from consideration. Claims 2-5 and 19 and new Claim 21 are active in the case. Reconsideration is respectfully requested.

The present invention relates to a nonaqueous secondary battery.

A number of types of nonaqueous secondary batteries are known which a typical one is a lithium ion secondary battery which employs a material which is capable of occluding and liberating lithium ions from the negative electrode of the battery and comprises a positive electrode. In recent years, in view of the increase in demand for secondary batteries to power electronic equipment, which batteries can be recharged and discharged and which have a high

energy density has increased. While metallic lithium as the negative electrode of such batteries provide an electric potential at its largest negative value, nevertheless, upon repeated charge and discharge of the battery, dendrites of lithium form at the negative electrode these dendrites result in decreased performance of the battery as well as a high risk of internal short circuits of the battery.

Various active replacement materials for lithium as the negative electrode in such secondary batteries have been proposed. One such proposal is the selection of a sulfide out of a number of transition metals. However, a need continues to exist for a nonaqueous secondary battery which exhibits high voltage and high energy density characteristics and which produces few dendrites of lithium when the battery is repeatedly charged and discharged.

The discovery of the present invention is a negative electrode of a nonaqueous secondary battery which exhibits improved characteristics which negative electrode is formed of a sulfide compound of formula (1): A_aS, wherein A is copper, silver or gold and $0.4 \leq A \leq 5$, and further wherein the amount of metal sulfide material in the negative electrode is at least 75% by weight or more of the composition of the negative electrode.

In another embodiment of the invention as set forth in Claim 19, the active material of the negative electrode is a material selected from three different sulfide compounds having formulas (1), (2) or (3), wherein the metal elements A, B, D, E, G and J are as defined in the claim and element M is as defined in Claim 19.

Claims 1, 2, 4 and 5 stand rejected based on 35 U.S.C. §102(b) as anticipated by Plichta et al, U.S. Patent 5,154,990. This ground of rejection is respectfully traversed.

The Plichta et al reference represents prior art which is relevant to the present

invention since it discloses a rechargeable solid state lithium ion electrochemical system wherein a possible embodiment of the anode of the electrochemical cell is copper sulfide (column 3, line 12), among other possible sulfide and oxide metal compounds. However, as disclosed, for instance, at column 2, lines 13-33, the electrolyte employed in the electrochemical system of the reference is a solid lithium ion containing electrolyte. Please note that the electrochemical system as claimed in the reference is also limited to this solid lithium ion containing electrolyte. This feature of the electrochemical system of the reference is at variance with the requirements of the nonaqueous secondary battery of the present invention which positively requires a nonaqueous electrolytic solution as the electrolyte. This significance of this distinction is further highlighted by the disclosure in the reference at column 3, lines 3-6 where the reason for not employing a lithium-organic solvent electrolyte is expressed, which is that strongly solvated ionic species tend to irreversibly cointercalate into the electrode lattice structure which results in significant capacity losses of the cell. The reference then indicates that the "solid state" cell of the patent eliminates this undesirable effect. Accordingly, Claims 1, 2, 4 and 5 are believed patentably distinguished over the '990 reference and withdrawal of the rejection is respectfully requested.

Claims 1-5 stand rejected based on 35 U.S.C. §102(b) over EP '104. This ground of rejection is respectfully traversed.

The '104 publication discloses a solid electrochemical element comprising solid negative and positive electrodes and an electrolyte. As disclosed at the top of page 4 of the reference, suitable materials from which the negative electrode of the device of the reference is formed include Cu_2S powder and Ag_2S powder. However, like the electrochemical device of the Plichta et al reference, the device of the '104 reference requires a solid electrolyte as

described in the middle of page 3 of the specification of the publication. Thus the reference does not disclose an electrochemical device requiring the use of a nonaqueous electrolytic solution as the electrolyte. Accordingly, the present claims are believed distinguished over the reference, and withdrawal of the rejection is respectfully requested.

Claims 1, 4 and 5 stand rejected based on 35 U.S.C. §103 as obvious over Kobayashi et al, U.S. Patent 5,998,063. This ground of rejection is respectfully traversed.

The Kobayashi et al reference is germane to the present invention in that it discloses a secondary lithium cell having electrodes described as a positive pole comprising cathode active material and a negative pole comprising anode active material, along with a separator and an electrolyte, all within a cell case. Considering the disclosure at column 4, lines 18-27 of the reference, Figure 1 and the description of the negative pole at the bottom of column 5 to the top of column 6 of the reference, it is clear that the negative pole or electrode denoted as 1103 in Figure 1 is comprised of two portions, one of which is the primary negative electrode 1101 formed from "a substance containing lithium" (See column 7, line 61 to column 8, line 19 for lithium containing substances.) while the second portion of the electrode is identified as 1102 and is a body of cathode active material, examples of which are described in column 10, lines 50-58 of the text of the patent. These cathode active materials include the sulfides of copper, silver and gold. In a similar fashion the positive pole or electrode 1003 is formed of a main body 1001 of cathode active material and a portion of anode active material 1002. Accordingly, it is evident that the patent does not include the material identified in the present claims as A_aS as an anode active material, but only as a cathode active material, which is in direct contrast to the teachings of the present invention. The reason patentees form a negative pole from a main body of anode active material and a

small or minor body of cathode active material is described at column 3, lines 50-55 of the text which is that, during operation, in the negative pole lithium is released from the pole by the body of cathode active material in order to prevent the negative pole from being excessively discharged before the end of the release of Li from the cathode active material of the negative pole.

It is important to note that the amount of cathode active material incorporated in the negative pole is minor in comparison to the amount of anode active material used to form the main body of the negative pole. This is clear from the examples of the patent wherein the contents of cathode active materials of negative poles are 10 % by wt in Example 1 ($LiMoS_2$), 10 % by wt in Example 2 ($LiTiS_2$) and 20 % by wt in Example 7 ($Li_{4/3}Ti_{5/3}O_4$). Example 8 of the patent shows the relationship between the additional amount of lithium-titanium oxide incorporated in the negative pole and the cycle life of the cell. It is explicitly state that cycle life of a cell can be improved as long as the added amount of cathode active material is within the range of 3 to 60 % by wt. Note in particular that Table 2 of the patent specifically demonstrates that if the amount of cathode active material added to the negative electrode is 70 % or more, the cycle life of the cell is shortened. On the contrary, as Claims 1 and 19 now state, the amount of an added active material such as A_aS should be at least 70 % by wt in order to have a properly functioning negative electrode. Accordingly, it is clear that the teachings of Kobayashi et al do not lead the skilled artisan to the negative electrode of the present invention and therefore withdrawal of the obviousness ground of rejection is respectfully requested.

Claim Amendments

Claim 1 (new claim 21) and Claim 19 have been amended to recite the quantity of a material of formula 1, 2 or 3 incorporated in the negative electrode of at least 75 % by wt. Support for this amount of material can be found on page 10, lines 25-29 and on page 11, lines 13-16 where, if the sum of the amounts of binder and conductive material ranges from 1.0 to 25 % by wt with the maximum amount of binder set at 10 % by wt and the maximum amount of conductive material set at 15 % by wt, the minimum amount of negative active material must be 75 % by wt. Accordingly, the limitation added to Claims 1 (new claim 21) and 19 is supported by the text and is not new matter.

Also support for the added limitation of Claim 1 (new Claim 21) of the nonaqueous electrolyte solution can be found, for instance, on page 13 of the specification. Accordingly, the limitation does not constitute new matter in the claims.

Claim 5 stands rejected based on 35 U.S.C. §112, second paragraph. This ground of rejection is obviated by the amendment made to the claims. Note that support for the sulfide $Au_{0.5}$ is believed to be found in the range for a recited on page 6, line 19 of the specification. Withdrawal of the rejection is respectfully requested.

It is now believed that the application is in proper condition for allowance. Early notice to this effect is earnestly solicited.

Respectfully submitted,

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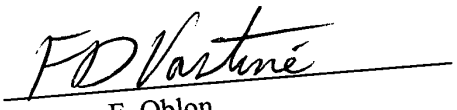

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